PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Electric Accumulators.

I, Guglielmo Marconi, G.C.V.O., D.Sc., of Marconi House, Strand, London, England, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to electric accumulators in which chlorine is employed as the active element at the positive pole and zinc or other metal at the negative pole.

According to this invention I employ a solution of the chloride of an alkali or alkaline earth, preferably chloride of calcium, together with the chloride of zinc. The positive electrode consists of a rod of carbon contained in a porous cylinder, the space between the rod and the interior wall of the cylinder being packed with grains of low resistance carbon, which is preferably porous. Around the porous cylinder is arranged a cylinder formed either of metallic gases, preferably of copper or iron, which has been coated with zinc and amalgamated, or of perforated strips of electrolytic zinc; this constitutes the negative electrode.

Preferably, however, I employ a number of porous cylinders each containing powdered carbon and a carbon rod, and each surrounded by gauze, the whole number being surrounded and bound tightly together by gauze which is in contact with the interior wall of a cylindrical container constructed to withstand considerable internal pressure. The solution is introduced into the container leaving a space at the top into which air or hydrogen is forced to a pressure of the order of twenty atmospheres.

When the accumulator is stationary during use it is desirable to induce a circulation of the liquid, and I therefore preferably introduce into the liquid a circulating tube through the axis of which passes another tube containing a coil which may be connected to the terminals of the accumulator, so that during charging and discharging current will pass through and heat the coil and thus cause an upward flow of liquid through the first mentioned tube and a general circulation of the whole solution.

The action of the accumulator is as follows:—

During charging the chloride of zinc is decomposed into chlorine and zinc. The latter is deposited on the surface of the gauze constituting the negative electrode, and the chlorine which is liquefied by the pressure is partly absorbed by the powdered carbon, while some remains in the solution. Such liquefaction of chlorine by pressure has formerly been proposed in accumulators containing chloride of zinc. During discharge the reverse action takes place, the anions of

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chlorine and the kations of zinc recombining to form chloride of zinc. The pressure of the calcium chloride prevents shortcircuiting being caused owing to the growth of filaments of zinc through the pores of the cylinders containing the positive electrodes, and decreases the diffusion of the chlorine through the liquid.

Whilst I prefer calcium chloride as being cheap and extremely soluble, I may employ in place of it the chloride of some other alkali or alkaline earth metal, such as common salt.

In the accompanying drawings, Figure 1 is a diagrammatic vertical section through an accumulator constructed in accordance with my invention and Figure 2 is a part horizontal section.

a is a cylindrical container of steel having its interior coated with zinc to a thickness of from 1 to 2 mm. It is closed at the bottom by an insulated cover *b*. *c c* are porous cylinders of asbestos or porcelain; for the sake of clearness these are shown separate from one another; in reality, however, they are in contact throughout their length; each is surrounded with gauze *d* of copper or iron wire coated with zinc and amalgamated, and the whole assemblage is bound together by a cylinder of similar gauze which fits close against the interior of the container *a*. In the middle of each cylinder *c* is a rod *e* of carbon having a metallic core *f* to increase its conductivity, the remainder of the interior of the cylinder being filled with powdered or granular porous carbon *g* of low resistance. The cores *f* are not essential, but if they are employed the carbon rods should be rendered impermeable by mixing with the paste of which they are formed a small quantity of a vitreous substance, such as an insoluble silicate or quartz. The lower end of each cylinder *c* is closed by a plug *h* of insulating cement unaffected by chlorine.

The ends of the cores *f*, or of the rod *e* if cores are not employed, are electrically connected to a disk *i* of wire gauze connected to the cover *b* by solder *j*.

k is a layer of insulating cement, such as sealing wax, asphalt or a mixture of bitumen and pitch, introduced hot through a tube *l*. Above the top of the cylinders *c* is a layer of zinc coated wire gauze or carbon grains *m*. *n* is an aqueous solution of calcium chloride and zinc chloride which can be introduced through a cock *o*. *p* is a pressure gauze filled with oil to prevent any corrosive action upon it, and *q* is a safety valve. In the centre of the assemblage of cylinders *c* is a circulating tube *r* formed of porcelain and lined with asbestos, through which passes a closed tube *s* of metal coated with zinc and containing a coil the ends of which are connected to binding screws *t*. *u* is the positive terminal of the accumulator and *v* the negative terminal.

I have used with success an accumulator having the following dimensions:—

Internal diameter of container -	20 cm.
Height - - - - - -	50 cm.
Number of cylinders *c* - -	300
Internal diameter of *c* - -	8 mm.
Thickness of sides of *c* - -	1 mm.
Diameter of rods *e* - - -	5 mm.
Diameter of cores *f* - -	1 mm.

Gauze *d* is formed of wire of 0.2 mm. diameter of close mesh, weighing approximately 8 grams per square decimetre.

The solution should be prepared with distilled water, and the chlorides of calcium and zinc should be pure and free from metals more electro negative than zinc.

The solution may consist of:—

600 gms. water

500—550 gms. of dry chloride of calcium, and

400 gms. of chloride of zinc.

For accumulators in which weight and size are not of essential importance, it is possible to increase advantageously the diameters of the cylinders *c* and the thickness of their sides.

An accumulator so constructed has a capacity of about 1100 ampere hours with a voltage of from 2 to 2.2 volts

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. An electric accumulator containing a solution of the chloride of zinc and of the chloride of an alkali or alkaline earth, substantially as described.

2. An electric accumulator containing a solution of the chloride of zinc and of the chloride of an alkali or alkaline earth under pressure, substantially as described.

3. In an electric accumulator, the combination of a closed container, a number of porous cylinders therein each containing a carbon rod and packed with powdered carbon gauze or the like surrounding the cylinders, and a solution of the chloride of zinc and of the chloride of an alkali or alkaline earth under pressure, substantially as described.

4. In an electric accumulator, the combination of a closed container, a cylinder of gauze and the like, a number of porous cylinders each containing a carbon rod and packed with powdered carbon, a solution of the chloride of zinc and of the chloride of an alkali or alkaline earth under pressure and a circulating tube adapted to be heated by the current from the accumulator, substantially as described.

Dated this 5th day of April, 1918.

CARPMAELS, RANSFORD &
NEWTON,
Agents for Applicant,
24, Southampton Buildings, London,
W.C.2.

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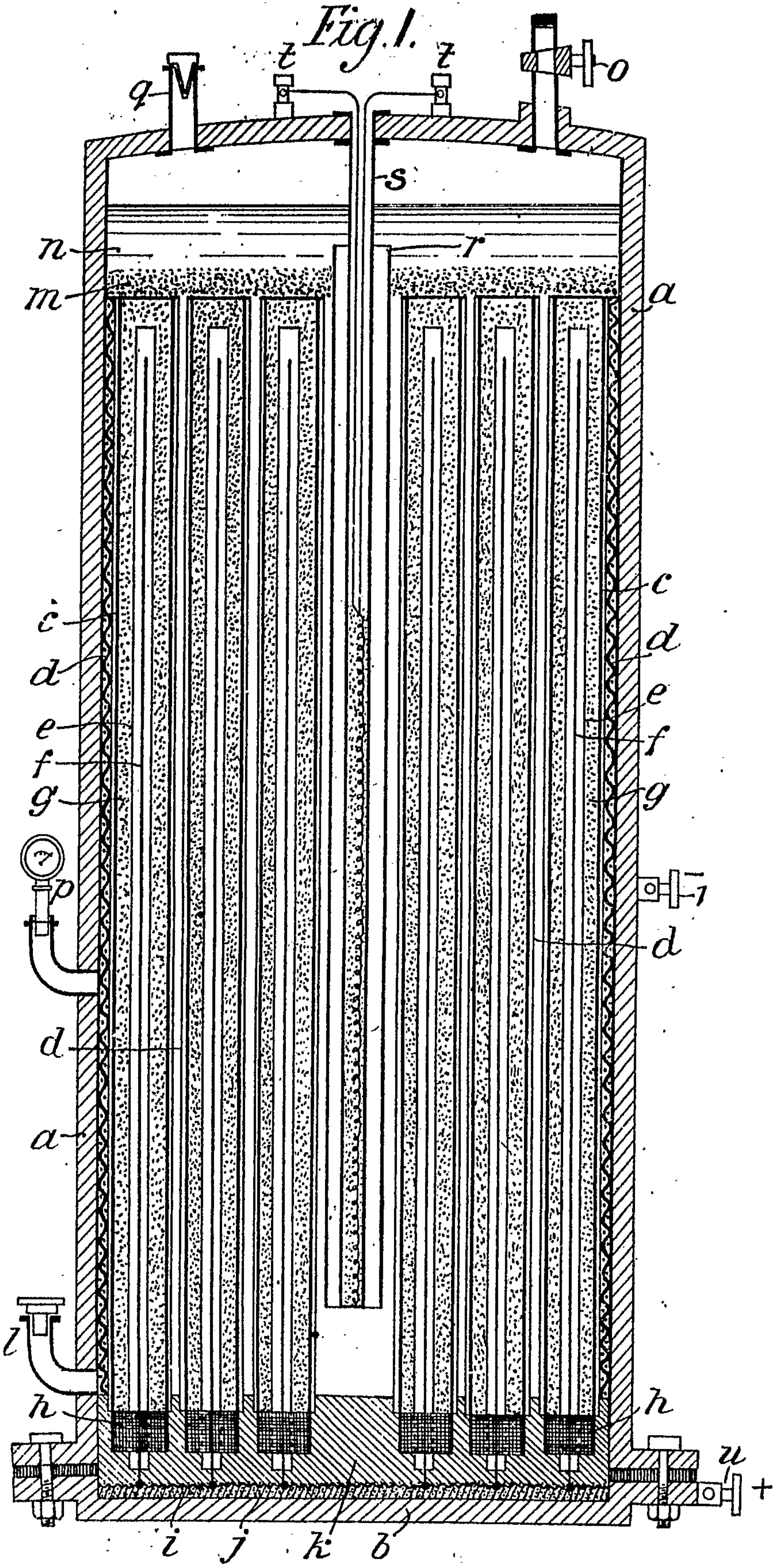
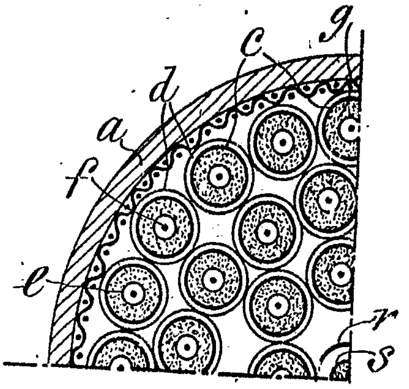
Fig. 1.



(2 SHEETS)

SHEET 2

Fig. 2.



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